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# DESIGN OF A STAR SHAPED DIELECTRIC RESONATOR ANTENNA FOR 5G TECHNOLOGY

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Abstract: In this paper, a star shaped Dielectric Resonator Antenna (DRA) is designed. The proposed antenna system resonates at a dual band of 28.3GHz and 37 GHz at -10 dB return loss. The S-Parameters, VSWR (Voltage Standing Wave Ratio), and radiation pattern of the proposed antenna are presented. The proposed antenna covers most of the Ka-band (28 to 40 GHz) making it suitable for 5G wireless communication applications

Keywords: DRA, return loss, bandwidth, 5G wireless application.

## 1. INTRODUCTION

The development of 5G Technology is to increase the data rate of Wireless communications. Previous mobile technology like 4G (Babu et al, 2011), use the frequency band of 2-8GHz, and the data rate is more than 20Mbps, while the 3G technology operates in the frequency band of 1.8-2.5GHz and the data rate is 2Mbps. For the developing 5G technology (Rensheng et al, 2016) the frequency bands specified by FCC are 28GHz and 37GHz (Nor et al, 2016b), for which the data rate is up to 1Gbps.

For the deployment of the 5G technology, the preferred antennas are either microstrip antenna or Dielectric Resonator Antenna (DRA). Microstrip antennas usually suffer from narrow bandwidth. The metallic and surface loss of this antenna may decrease antenna gain and efficiency at millimetre wavelenths. Dielectric resonator Antennas are the preferred choice, when the device is to be operated at high speed wireless communications (Babu et al, 2014). These antenna reduces the losses at millimeter frequency band also. DRAs have many additional advantages, like higher radiation efficiency, higher gain, ease of excitation , absence of surface currents etc. Due to these advantages, DRA operates with good performance at millimeter wave frequency band.

A review article on DRA antennas mentioned in (Petosa et al, 2010), suggests the suitability of these antennas for 5G applications. The antennas designed for 5G applications must have good radiation properties with good efficiency characteristics and smaller size, where DRAs are the most prominent option. In (Pan et al, 2011) it is described a rectangular DRA suitable for 5G applications. The cited work explained the dependence of antenna size on various modes excited by the antenna. Also, the work studied the fabrication tolerances on the antenna excitation modes.

In (Nor et al, 2016a) a novel rectangular DRA resonating at 28 GHz, the ideal frequency for 5G applications, is presented. In this solution, the proposed antenna is included in an antenna array in order to to improve the gain, which is an important parameter for 5G applications. The resulting antenna array has a bandwidth of 2.1 GHz and a gain of 12.1 dBi in the desired operating frequency range.

In the present work, a Star shaped Dielectric Resonator Antenna resonating at multiple bands of frequencies is developed. The developed antenna resonates at both the intended 5G bands i.e 28 GHz and 37 GHz

## 2. ANTENNA DESIGN

The proposed Star Shaped Dielectric Resonator Antenna shown in figure 1.The design of DRA antenna has three layers. They are ground, substrate and radiating dielectric material. In the design of DRA antenna, major radiating element is DRA. The DRA material is a substance that is a poor conductor of electricity. The various dimensions of the antenna are characterized using parametric analysis. The optimized dimensions of the antenna are taken as 12×12 mm (L=12 mm, W=12 mm) and length L1= 8mm, width W1=8mm, width W2=3mm, width W3= 1.5mmand width W4=2mm. The radiating dielectric material is made with a dielectric material of permittivity $\varepsilon_r$ = 13.9 and height H = 4 mm. The dimensions of the antenna are optimized by using the EM simulator. The antenna is placed on a substrate of permittivity value $\varepsilon_r$ = 2.2 and height h = 2.9 mm. The simulated model of the proposed Star Shape Dielectric Resonator Antenna is shown in figure 2.

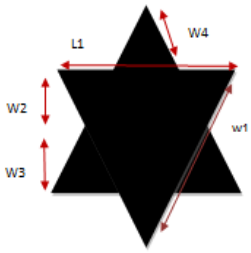


Fig.1. Star Shaped DRA

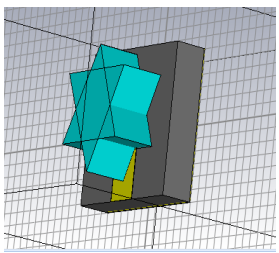

Fig.2. Model of the star shaped DRA used in simulation

## 3. EXPERIMENTAL RESULTS

The antenna is simulated using CST software and the S-Parameters of the proposed antenna are shown in figure 3. From the obtained S- Parameters, it can be observed that the antenna resonates at a dual band of frequencies 28.3GHz and37GHz making it suitable for Ka band 5G wireless communication.

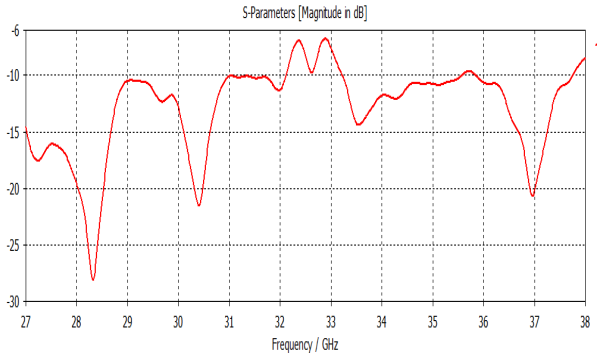


Fig.3. S parameters of the proposed antenna

The voltage standing wave ratio(VSWR) of the Star Shaped Dielectric Resonator Antenna are shown in figure 4.

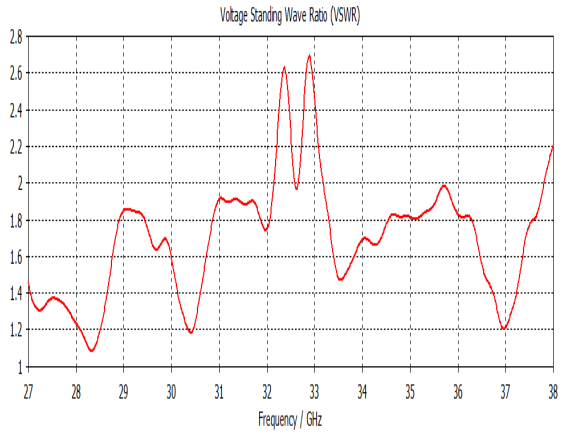


Fig.4. VSWR plot of the proposed DRA.

The radiation patterns of the proposed Star Shape Dielectric Resonator Antenna at 28.3GHz and 37GHz are shown figures 5-8.

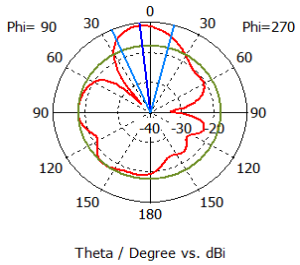


Fig.5. Radiation pattern on H-Plane at 28.3GHz

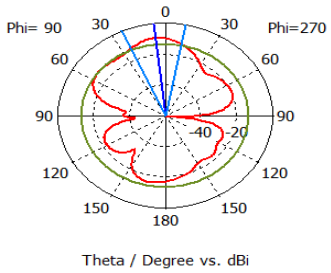


Fig.6. Radiation pattern on H-Plane at 37GHz

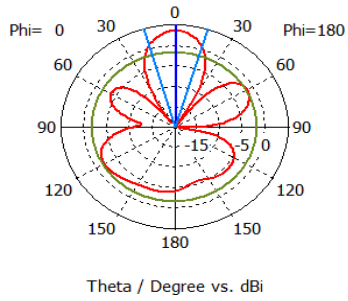


Fig.7. Radiation pattern on E-Plane at 28.3GHz

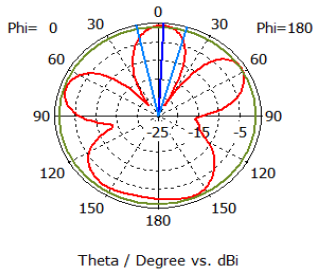


Fig.8. Radiation pattern on E-Plane at 37GHz

## 4. CONCLUSION

In this paper, a Star shaped Dielectric Resonator Antenna is designed to operate at a dual band of frequencies 28.3 GHz and 37 GHz. The important antenna parameters like reflection coefficient, VSWR and radiation patterns of the developed antenna are presented. The proposed antenna resonates at 28.3GHz and 37GHz suitable for future 5G applications.

## 5. REFERENCES

K. Jagadeesh Babu, K. Sri Rama Krishna, L. Pratap Reddy, "A review on the design of MIMO antennas for upcoming 4G communication", International Journal of Applied Engineering Research, Dindigul, Volume 1,No 4, 2011.

K. Jagadeesh Babu and K. Sri Rama Krishna," A Novel Swastika Shaped Dielectric Resonator Antenna for MIMO Systems", IEEE International Microwave and RF Conference (IMaRC), 2014.

N. M. Nor, M. H. Jamaluddin, M. R. Kamarudin1, and M. Khalily2, "Rectangular Dielectric Resonator Antenna Array for 28GHz Applications", Progress In Electromagnetics Research C, Vol. 63, 53–61, 2016a.

N. M. Nor, M. H. Jamaluddin, M. R. Kamarudin and M. Khalily," Rectangular Dielectric Resonator Antenna Array for 28GHz Applications" Progress In Electromagnetics Research C, Vol. 63, 53–61, 2016b.

Pan, Y. M., K. W. Leung, and K. M. Luk, "Design of the millimeter-wave rectangular dielectric resonator antenna using a higher-order mode," IEEE Trans. Antennas and Propag., Vol. 59, 2011.

Petosa, A. and A. Ittipiboon, "Dielectric resonator antennas: A historical review and the current state of the art," IEEE Antennas and Propag. Mag., Vol. 52, 2010

Rensheng Xie, Jie Cao, Rongwei Wang, Xi Wang, Zhi Xu, and Shouzheng Zhu, "A Study of Dielectric Resonator Antenna Array Applied to 5G Communication System" Progress In Electromagnetic Research Symposium (PIERS), Shanghai, China, 8–11 August 2016.